

Report No. UT-13.11

## REDUCING HIGHWAY LITTER

### Prepared For:

Utah Department of Transportation  
Research Division

### Submitted By:

University of Utah  
Department of Civil and Environmental  
Engineering

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**Final Report**  
**June 2013**

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## **ACKNOWLEDGMENTS**

The authors acknowledge the Utah Department of Transportation (UDOT) for funding this research, and the following individuals from UDOT on the Technical Advisory Committee for helping to guide the research:

- Lynn Bernhard
- W. Scott Jones

## TECHNICAL REPORT ABSTRACT

1. Report No. UT- 13.11		2. Government Accession No. N/A		3. Recipient's Catalog No. N/A	
4. Title and Subtitle REDUCING HIGHWAY LITTER				5. Report Date June 2013	
				6. Performing Organization Code	
7. Author(s) Otakuye Conroy-Ben, Ph.D., and Travis Christensen				8. Performing Organization Report No.	
9. Performing Organization Name and Address University of Utah Department of Civil and Environmental Engineering 110 S Central Campus Dr., Room 2000 Salt Lake City, UT 84112				10. Work Unit No. 8RD1411H	
				11. Contract or Grant No. 13-8666	
12. Sponsoring Agency Name and Address Utah Department of Transportation 4501 South 2700 West P.O. Box 148410 Salt Lake City, UT 84114-8410				13. Type of Report & Period Covered Draft Final May 2013 to June 2013	
				14. Sponsoring Agency Code PIC No. AM 13.004	
15. Supplementary Notes Prepared in cooperation with the Utah Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration					
16. Abstract  The objective of this report is to evaluate the status of highway litter in the State of Utah. Under the direction of Russ Scovil, engineer with the Utah Department of Transportation (UDOT), researchers at the University of Utah performed a literature review on highway litter and interviewed essential members of the Technical Advisory Committee (TAC). The TAC consists of a project manager, UDOT personnel, and faculty and a graduate assistant from the University of Utah's Department of Civil and Environmental Engineering.  UDOT provided data on litter types, problematic highway litter locations, litter clean-up costs, accidents caused by road debris, The major findings of this study are summarized below. <ul style="list-style-type: none"> <li>• Types of litter encountered include fast food waste, plastic bags, soda bottles and cans, tire shreds, and loose-leaf paper, among others</li> <li>• The annual clean-up cost of highway litter to the state of Utah in the past 5 years ranged from \$1.53 million to \$1.83 million</li> <li>• There are 6 stretches of highway designated as problem areas</li> <li>• The number of accidents caused by highway debris range from 650 to 800 each year</li> </ul>					
17. Key Words Highway litter, highway litter accidents			18. Distribution Statement Not restricted. Available through: UDOT Research Division 4501 South 2700 West P.O. Box 148410 Salt Lake City, UT 84114-8410 <a href="http://www.udot.utah.gov/go/research">www.udot.utah.gov/go/research</a>		23. Registrant's Seal N/A
19. Security Classification (of this report)  Unclassified		20. Security Classification (of this page)  Unclassified		21. No. of Pages  24	22. Price  N/A

## TABLE OF CONTENTS

LIST OF TABLES .....	v
LIST OF FIGURES .....	vi
EXECUTIVE SUMMARY .....	7
1.0 INTRODUCTION .....	8
1.1 Problem Statement .....	8
1.2 Objectives .....	8
1.3 Scope.....	8
1.4 Outline of Report .....	8
2.0 LITERATURE REVIEW .....	9
2.1 Littering Behavior.....	9
2.2 Cost of Litter.....	9
2.3 Source of Litter .....	9
2.4 Unintentional vs. Deliberate Littering .....	9
2.5 Type and Amount of Litter .....	9
2.6 Campaigns .....	9
2.7 Paid Litter Programs .....	10
2.8 Prevention .....	10
2.9 Fines.....	10
2.10 Other DOT Efforts .....	10
3.0 STATUS OF HIGHWAY LITTER IN UTAH.....	11
3.1 Type of Litter .....	11
3.2 Source of Litter .....	11
3.3 Location of Litter .....	11
3.4 Accidents Caused by Road Debris.....	11
3.5 Accidental vs. Deliberate Littering.....	12
3.6 Field Verification .....	12
3.7 Cost of Litter to UDOT.....	13
3.8 Recommendations for Maintenance and Prevention .....	14

REFERENCES .....	15
APPENDIX A: TECHNICAL ADVISORY COMMITTEE.....	17
APPENDIX B: SUPPLEMENTAL DATA.....	18
APPENDIX C: MAPS .....	21
APPENDIX D: DOT HIGHWAY LITTER DATA .....	23

**LIST OF TABLES**

Table A.1 Members of the Technical Advisory Committee.....17

Table C.1 Table C1. Description of locations for windshield survey..... 22

Table D.1 Summary of State DOT Highway Litter Data. ....23

## LIST OF FIGURES

Figure 3.1 Number of litter-related accidents, 2008 – 2012 .....	12
Figure 3.2 Total costs for highway litter clean-up incurred by UDOT, 2005 – 2012	Error! Bookmark not defined.
Figure 3.3 Breakdown of highway litter costs based on clean-up activity .....	14
Figure B.1 Litter-related accidents by UDOT regions, 2008-2012 .....	18
Figure B.2 Breakdown of total highway litter clean-up costs by region, 2005-2012	Error! Bookmark not defined.
Figure B.3 Breakdown of highway litter clean-up costs in Region 1, 2010 – 2012	Error! Bookmark not defined.
Figure B.4 Breakdown of litter clean-up costs in Region 2, 2010 – 2012.....	19
Figure B.5 Breakdown of litter clean-up costs in Region 3, 2010 – 2012.....	20
Figure B.6 Breakdown of litter clean-up costs in Region 4, 2010 – 2012.....	20
Figure C.1 UDOT Regional Map.....	21
Figure C.2 High litter roadways visited during windshield survey.....	22

## **EXECUTIVE SUMMARY**

The objective of this report is to evaluate the status of highway litter in the State of Utah. Under the direction of Russ Scovil, engineer with the Utah Department of Transportation (UDOT), researchers at the University of Utah performed a literature review on highway litter and interviewed essential members of the Technical Advisory Committee (TAC). The TAC consists of a project manager, UDOT personnel, and faculty and a graduate assistant from the University of Utah's Department of Civil and Environmental Engineering.

UDOT provided data on litter types, problematic highway litter locations, litter clean-up costs, accidents caused by road debris. The major findings of this study are summarized below.

- Types of litter encountered include fast food waste, plastic bags, soda bottles and cans, tire shreds, and loose-leaf paper, among others
- The annual clean-up cost of highway litter to the state of Utah in the past 5 years ranged from \$1.53 million to \$1.83 million from 2008 - 2012
- There are 6 stretches of highway designated as problem areas, and a located in or near high traffic areas
- The number of accidents caused by highway debris range from 650 to 800 each year from 2008 to 2012
- Recommendations made by the TAC are similar to those enacted by other State's DOTs
- Littering on Utah highways follow national trends

## **1.0 INTRODUCTION**

### **1.1 Problems Statement**

The Utah Department of Transportation Senior Leaders have recognized a problem with an increase in litter on State highways along the Wasatch Front and are looking for ways to reduce this problem. This report will provide the necessary information so that UDOT can introduce an effective method to reduce the amount of litter along Utah State roads.

### **1.2 Objectives**

The objectives of this study are to conduct a literature search on the status of highway litter in the U.S., and to document the following in the State of Utah: litter type and percentages, the amount of litter, source of litter, litter location, is littering accidental or deliberate, field verification, cost of litter to UDOT, and recommendations for prevention.

### **1.3 Scope**

UDOT personnel and members of the Technical Advisory Committee were interviewed on their experiences with highway litter. The TAC also provided information on highway litter costs and highway accidents caused by litter. This report summarized the findings.

### **1.4 Outline of Report**

This report begins with a literature review of the highway litter problem, which then leads into the status of highway litter in Utah.

- Literature review
- Type of litter
- Source of litter
- Location of litter
- Accidents caused by road debris
- Accidental vs. deliberate littering
- Field verification
- Cost of litter to UDOT
- Recommendations for maintenance and prevention

## **2.0 LITERATURE REVIEW**

### **2.1 Littering Behavior**

Littering rates have declined drastically over the past 40 years. Two main factors which influence whether or not an individual will litter: age and a person's belief in the importance of litter [28]. The effect of age on littering behavior is that as age increases, littering behavior decreases. Individuals aged 19 and below are more likely to litter than any other age group. Behaviors which increased littering were found to be a lack of ownership, a belief that someone else would clean up the litter, and already existing litter. However, people recognize that not littering results in a clean community, individuals accept ownership of a community's public places, and that people expect community leadership to accept a role in community change [27].

### **2.2 Cost of litter**

A survey of state DOTs provided that the cost of roadside litter collection and disposal is \$430 to \$505 per center-line mile (both sides of the road) [29]. State-specific costs are found in Table D1.

### **2.3 Source of litter**

A significant amount (97%) of litter comes from four sources: pedestrians (42%), vehicle occupants (20%), unsecured loads on trucks (21%), and vehicle beds where items have been improperly stowed (14%) [29]. Gender is not a significant predictor of littering behavior. Past research has concluded that men are more likely to litter than women, but men are more likely to report littering [28]. In another study, men are 2X more likely to litter than females, and adults under the age of 35 are more likely to litter than those that are older by 2-3 times.

### **2.4 Unintentional vs. Deliberate Littering**

From state-to-state, the amount of unintentional littering varies greatly from 35% to 70% [27]. Stein and Syreck found that 55% of litter is deliberate and that litter varies with roadway type. Half of litter on urban freeways and 53% of litter on rural roads is accidental. Accidental litter is much less on rural local roads and rural state highways (36% and 39% respectively) [29]. A visual survey of 130 sites showed that 81% of the observed littering was done intentionally [28].

### **2.5 Type and Amount of Litter**

Results of 10 litter studies performed over the past 20 years showed that miscellaneous paper and plastic were ranked number 1 or 2 in 5 out of 10 studies; vehicle debris comprised a high amount of the visible litter; beverage containers ranked number 1 or 2 in only two of the 10 studies; aside from cigarette butts, miscellaneous paper, plastic, snack packaging, and take-out food containers account for 50% of roadside litter [27]. In another study, 130 locations across the U.S. were surveyed and it was determined that the most frequent items found at the observed sites were cigarette butts and food wrappers [28].

### **2.6 Campaigns**

Litter is decreasing at an average rate of about 2% per year. This drop indicates that litter reduction, education, and cleanup efforts may be successful in their endeavors. A program may be successful if consistent and regular messages are delivered, the community is encouraged and volunteers are motivated, partners are developed with supporting agencies to increase awareness

and consequences, and various methods of public education and outreach are employed. Depicting a roadside without litter is more effective than advertisements or promotional materials with a littered environment [29]. Education may influence an individual's choice to litter. Anti-littering websites are used by 53% percent of respondents in one study, while only 11 of the 39 respondents were familiar with Keep America Beautiful. Forty-six percent (46%) of the respondents indicated that their state had a litter hotline to report offenders [29].

One of the primary obstacles in developing effective litter control campaigns is the lack of reliable data. Campaigns are not successful likely because littering is not important, people had little previous involvement, there are little personal benefits, it is inconvenient, the demand for a litter-free environment is not strong, and the anti-litter message is difficult to develop [29]. It has been found that it can take up to 15 years to see the results of an anti-litter campaign.

## **2.7 Paid Litter Programs**

While paid litter pickup programs reduce the amount of garbage up to 90%, the litter will build back up within 7 to 31 weeks depending on the area. Paid litter removal is one of the most expensive methods to remove litter at a cost of \$1.29 per item. Adopt-A-Highway (AAH) programs are much cheaper at a cost of \$0.18 per item but AAH programs typically only cover 35% of state highways or less. On average AAH program have reduced the amount of highway litter by 13% but some states such as Hawaii and Pennsylvania have seen reductions of nearly 50% [29]. All but two states have Adopt-A-Highway programs. Most states (92%) use correctional work crews for litter collection [29].

## **2.8 Prevention**

Studies have shown that conspicuously decorated trash receptacles placed along the roadside can reduce roadside litter up to 28.6%, and these reductions were apparent up to 6 miles away. Using signs with positive language and placing trash receptacles along interstates have been found to reduce the amount of roadside litter [29]. In several studies, it was observed that "litter begets litter". A clean area will not be as likely to collect litter whereas an area with a lot of litter will tend to collect more. Efforts to remove litter need to be maintained or bolstered to prevent the buildup of future roadside litter [29].

## **2.9 Fines**

The average number of litter related citations appears to be dropping over time [29]. In one survey, 58% of the respondents indicated that littering is a criminal and not a civil offense, which are normally accompanied by fines, community service imprisonment, or restitution costs [29].

## **2.10 Other DOT Efforts**

A review of DOT offices across the country revealed similar observations from UDOT, although findings are unique to the state. The results are summarized in Table D1 (Appendix D).

## **3.0 STATUS OF HIGHWAY LITTER IN UTAH**

### **3.1 Type of Litter**

The type of litter that is found along Utah's highways varies greatly based upon location. Some types of litter that common along Utah's highways are: cans and bottles, cigarette butts, fast food packing and wrappers, paper, construction material, and human waste. Roadside litter is not limited to the items previously mentioned; items such as a boat without a trailer, a complete engine and transmission, and a load of toilets have been found [26].

### **3.2 Source of Litter**

The main sources of roadside litter along Utah's highways are drivers who improperly secure loads, smokers, fast food patrons, commercial vehicle operators, and negligent drivers [26].

### **3.3 Location of Litter**

The location of litter depends on many factors, including location, nearby businesses, load type, and recreation type. The location of the road typically has the greatest effect on the amount of roadside litter present. Roads and highways that have less traffic tend to have less litter. Areas which are less populated do not typically have as much litter on their roadways. Additionally, highways located near fast food restaurants and convenience stores have a tendency to have more litter from these establishments.

The type of load and user vary greatly along Utah's highways and also influences the roadside litter. SR 201, an arterial which provides access to the Salt Lake County Landfill. This highway is heavily littered with apparent unsecured trash loads from both commercial and private haulers. The I-15 corridor has high amounts of litter from construction projects most likely due to the economic development in the area. Recreation also dictates the amount of trash found along Utah's highways. High amounts of roadside litter have been observed in area where recreational vehicle use is common. This may be attributed to unsecured or improper storage of items in boats and on trailers. Roads leading up to ski resorts have very little litter in comparison which may be due to loads being stored within vehicles as opposed to outside in truck beds or trailers.

### **3.4 Accidents Caused by Road Debris**

Data analyzed from 2008 – 2012 on litter and debris related crashes on Utah's highways (Figure 3.1), showed that there were between 650 and 800 litter related accidents during this time period, though no obvious trend was observed over the time period. The number of traffic deaths has decreased in the past 5 years. In 2008, there were 3 litter-related traffic fatalities, none in 2009, one in 2010, none in 2011, and one in 2012.

The state of Utah is divided into four regions (1-4; Figure C.1 of Appendix C). Region 1 covers Box Elder, Cache, Rich, Weber, Morgan and Davis Counties; Region 2 covers Tooele, Salt Lake and Summit Counties; Region 3 covers Juab, Utah, Wasatch, Duchesne, and Uintah Counties; Region 4 covers the rest of the state. Looking at specific areas of Utah, most accidents occur in Region 2, following by Region 3, Region 1, and Region 4 (Figure B.1 of Appendix B). There was no apparent time-dependent trend between 2008 and 2012, but a noted decrease was recorded for 2010 in Regions 1, 2, and 4.

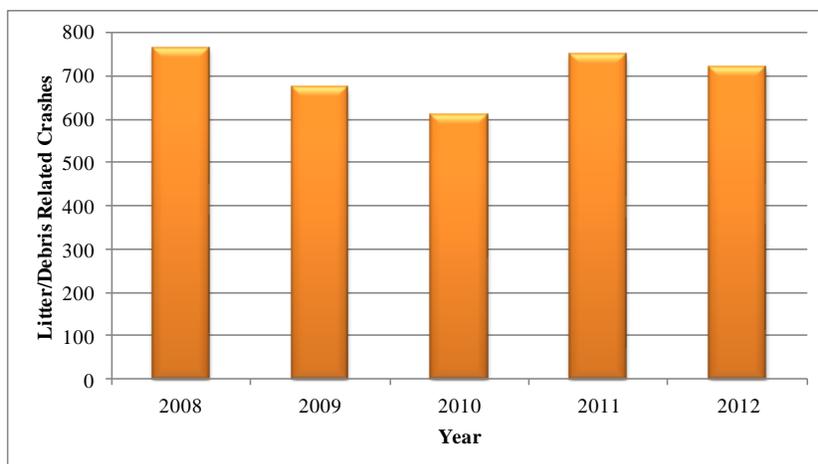


Figure 3.1. Number of litter-related accidents, 2008 – 2012.

### 3.5 Accidental vs. Deliberate Littering

Without a defined study, it's difficult to say how much litter is accidental. Up to 70 percent of roadside litter could be intentional. Nearly all of the cans, bottles, cigarette butts, and food and cigarette packing were littered intentionally. Thirty percent of items which are littered unintentionally are believed to come from loads which are secured improperly, or stripped from high winds [26].

### 3.6 Field Verification

Windshield surveys took place on June 12, 2013. A map can be found in Appendix C.

#### 3.6.1 SR-193 (Site 1)

This stretch of road starts at I-15 in Davis County just south of Hill Air Force Base, extending east to SR-89. Litter observed: Businesses and apartments generally kept litter from the sidewalk and lawn in front of their property. Cardboard boxes and plastic/paper bags collected along the fence of Hill AFB, though in small quantities (<10 total). Plastic bottles, paper, and cans were seen behind fences of homes in residential area. Litter in the roadway along the entire reach included a T-shirt, plastic bottles, pieces of wood, carpet pieces, and tire shreds. Plastic bags, bottles, paper were observed in open fields on either side of SR-193.

#### 3.6.2 I-15 from Mile 334 to Mile 333.4 (Site 2)

This stretch of freeway starts at the off-ramp to SR-193 extending to Mile 334, the end of the on-ramp of this interchange. Litter observed: Little litter was observed initially on either side of the on-ramp. Noticeable plastic bottles/bags further down the on-ramp on the right-hand side. Tire shreds are present on the shoulder of the interstate, as well as a cardboard box and plastic bottles.

#### 3.6.3 SR-201 from Mile 14.6 to Mile 8.7 (Site 3)

This stretch of road starts at the I-215 interchange and ends at approximately 7200 W. The focus area is the right-hand side heading west-bound. Small businesses and industrial companies lie along this reach up to Bangerter Highway. Beyond this stretch are open fields, a frontage road, and power lines. Litter observed: Tire shreds were present on the shoulder, as well as cardboard boxes, black plastic bags, and loose-leaf paper, purple plastic toys, anti-freeze containers.

### 3.6.4 SR-111 from Mile 10 to Mile 10.6 (Site 4)

This stretch of road lies in Magna, UT, north of two gas stations and extends to SR-201. Beyond the gas stations are agricultural fields on either side of the road of interest. Litter observed: Paper cups and plastic bags were observed just north of the gas stations. Near the agricultural fields were bottles and smaller shreds of paper. Litter along this highway may be intentional discards after individuals leave the gas station and before they enter the major highway SR-111.

### 3.6.5 SR-48 (Site 5)

This location starts at SR-111 and heads east through West Jordan. The stretch of highway starts in a rural area, then progresses to residential and small business. Litter observed: Initially, open fields were sporadically littered with plastic bags and bottles. Further along the stretch are apartments, a high school, and parks. Area in front of apartment complexes and businesses was generally clean. Often, litter was found in the road way, and was more dense near storm sewers.

### 3.6.6 SR-68 (Site 6)

Northbound SR-68 leads to the landfill from the small town of Elberta. On either side are agricultural fields bounded by a fence. The area is remote with no homes or businesses. Litter observed: Along the entire stretch, though infrequent, were soda cans, plastic bottles, plastic bags, loose leaf paper, and cardboard boxes. High weeds may have covered some litter. The litter observed was along the roadway or against the fence. It appears that the major source of litter is uncovered loads from waste management trucks.

## 3.7 Cost of Litter to UDOT

The cost of litter to UDOT for the period 2005 – 2012 ranged from \$1.5 to \$1.8 million (Figure 3.2). Total costs include litter control/contractual litter pick-up, spot litter control/carcass removal, and Adopt-A-Highway. Most costs are attributed to litter control and contractual removal, but these costs have been decreasing since 2005 (Figure 3.3). At one time, UDOT used prison crews until costs and contract requirements made their use uneconomic. Inmates received a small stipend, but most of the cost was in full time salaried guards and vehicles. UDOT was required to pay for a full crew for a full year even if they were not used due to weather or prison security issues.

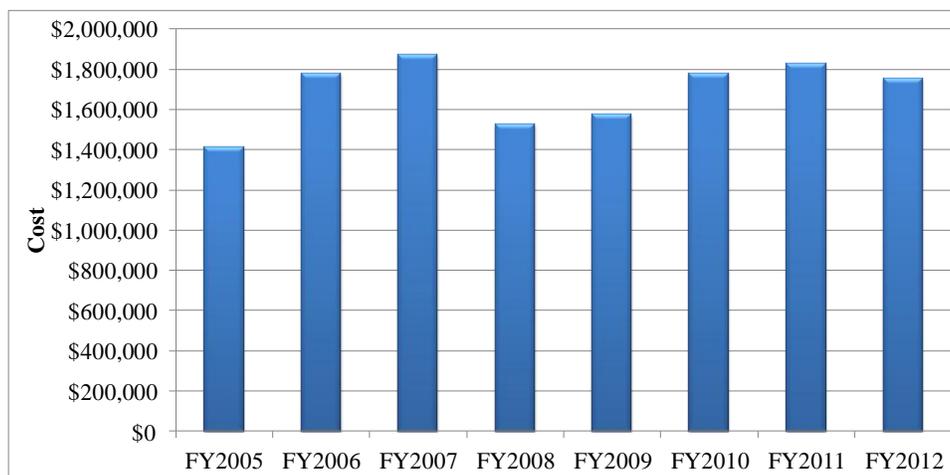


Figure 3.2. Total costs for highway litter clean-up incurred by UDOT, 2005 – 2012.

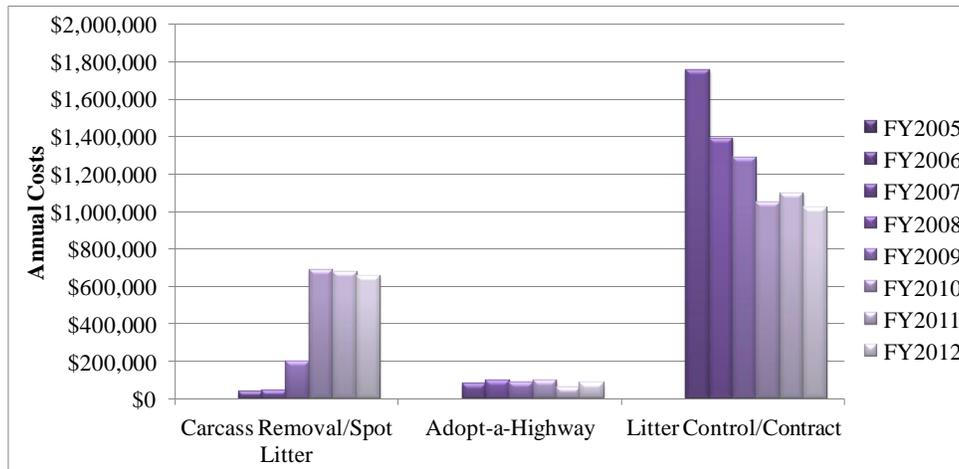


Figure 3.3. Breakdown of highway litter costs based on clean-up activity.

Clean-up costs by region vary depending on population and geography. Region 2 is the most expensive to clean up as expected, as this is the most populated area of the state, followed by Regions 4, 3, and then 1 (Figure B.2). In Regions 1 & 2 (Box Elder, Cache, Rich, Weber, Morgan and Davis Counties; Tooele, Salt Lake and Summit Counties), most costs are incurred by litter control (Figure B.3 and B.4). Given that Region 2 covers a metropolitan area, it is understandable that carcass removal costs are minimal. Since UDOT doesn't allow Adopt-A-Highway volunteers on busy freeways, this cost is also insignificant. In Region 3 (Juab, Utah, Wasatch, Duchesne, Uintah, and Daggett Counties), most highway litter clean-up costs are for spot litter/carcass removal (Figure B.5). These rural, mountainous areas have more animal traffic, increasing the probability of collisions on highways. In Region 4, clean-up costs are equally distributed between litter control and spot litter/carcass removal (Figure B.6). Adopt-A-Highway appears to play more of a role in rural areas of Utah than in metropolitan roads.

### 3.8 Recommendations for Maintenance and Prevention

The Technical Advisory Committee provided recommendations to prevent highway litter.

- Stop it at the source through cooperative awareness campaigns.
- Enact deposit laws in effect for bottles, cans, paper, and plastic bags.
- Retailers can provide "green reusable bag" programs that they offer users at a discount
- Utah's "Litter Hurts!" campaign was very effective in reducing the number of items that the Utah Highway Patrol had to remove from roads.
- School based awareness campaigns have proven most effective in modifying individual behavior in a number of causes.
- Picking up litter after the fact also has programs. Adopt-A-Highway is an all volunteer program used on low-speed roads and where volunteer risk is low.
- UDOT operates a Sponsor-A-Highway program where a contractor sells urban freeway professional litter collection to private sponsors in exchange for advertising.
- County and city prisoner crews and public restitution work crews are used in some areas at no cost to UDOT.
- Littering fines - A maximum of \$200 for private parties and \$1000 for commercial haulers, if it is the 2nd offense.

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**APPENDIX A – TECHNICAL ADVISORY COMMITTEE**

Table A.1 Members of the Technical Advisory Committee

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Kevin Griffin	Director of Maintenance	UDOT Champion	<a href="mailto:kgriffin@utah.gov">kgriffin@utah.gov</a>
Lynn Bernhard	Central Maintenance Engineer	Main source of information	<a href="mailto:lynnbernhard@utah.gov">lynnbernhard@utah.gov</a>
W. Scott Jones	Central Traffic & Safety	Accidents caused by debris information	<a href="mailto:wsjones@utah.gov">wsjones@utah.gov</a>
Nile Eastman	Central Director of Communications	Media campaign recommendations	<a href="mailto:neaston@utah.gov">neaston@utah.gov</a>
Adan Carillo	Regional Communications Manager	Media campaign	<a href="mailto:acarrillo@utah.gov">acarrillo@utah.gov</a>

**APPENDIX B – SUPPLEMENTAL DATA**

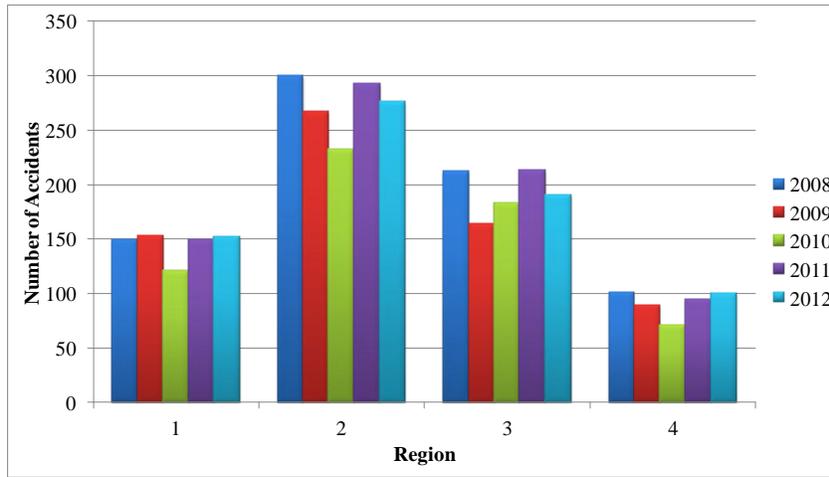


Figure B1. Litter-related accidents by UDOT regions, 2008-2012.

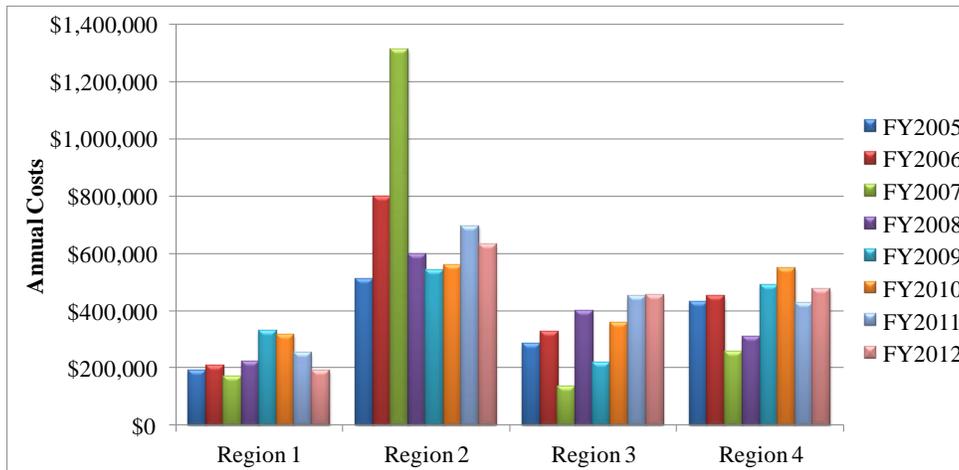


Figure B2. Breakdown of total highway litter clean-up costs by region, 2005-2012.

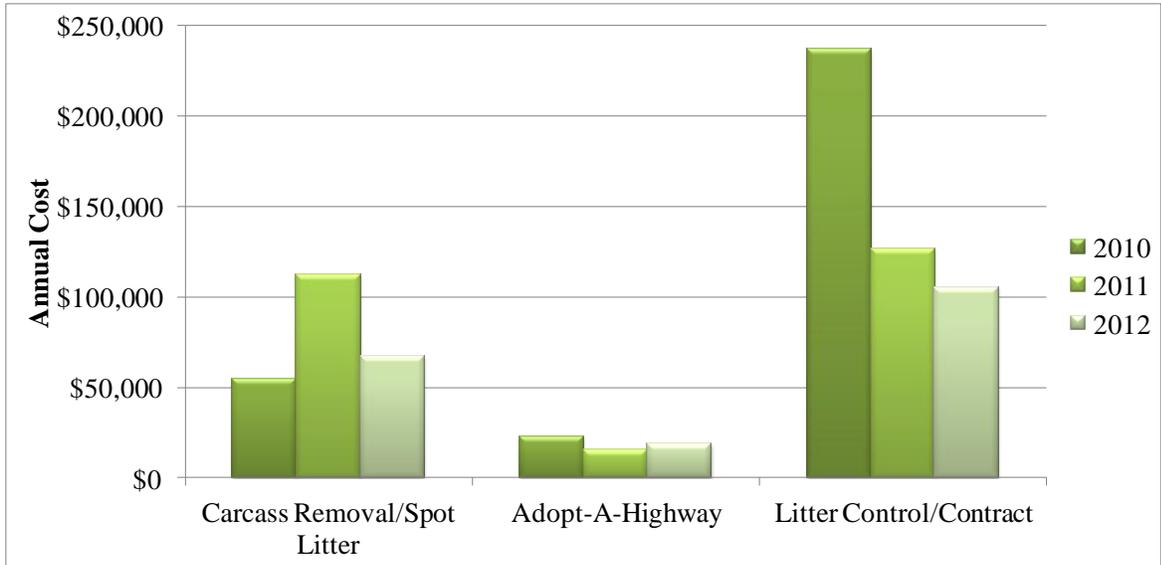


Figure B3. Breakdown of highway litter clean-up costs in Region 1, 2010 – 2012.

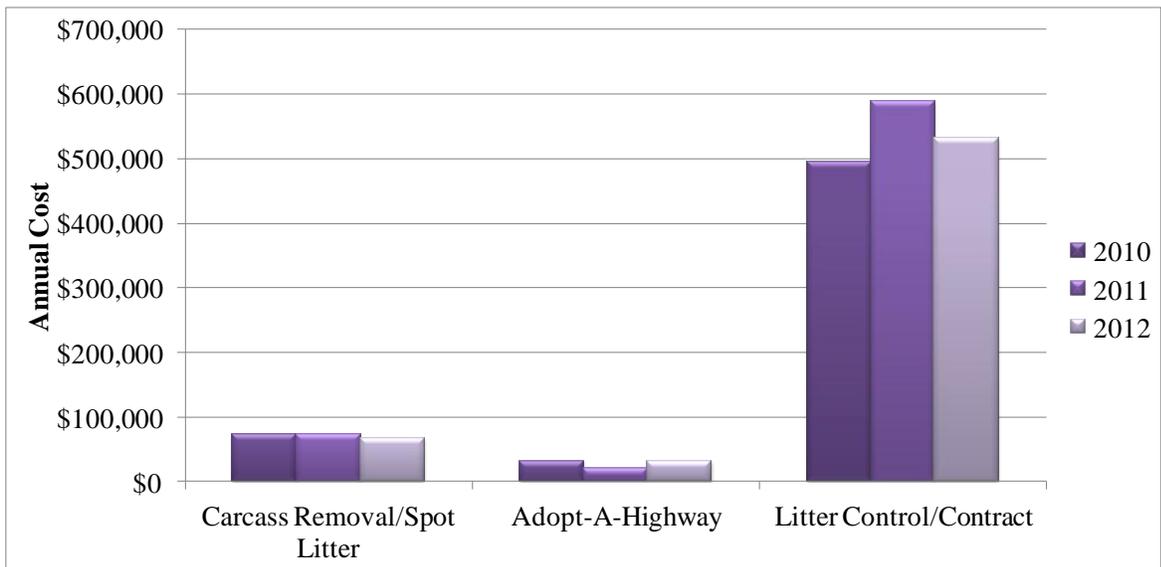


Figure B4. Breakdown of litter clean-up costs in Region 2, 2010 – 2012.

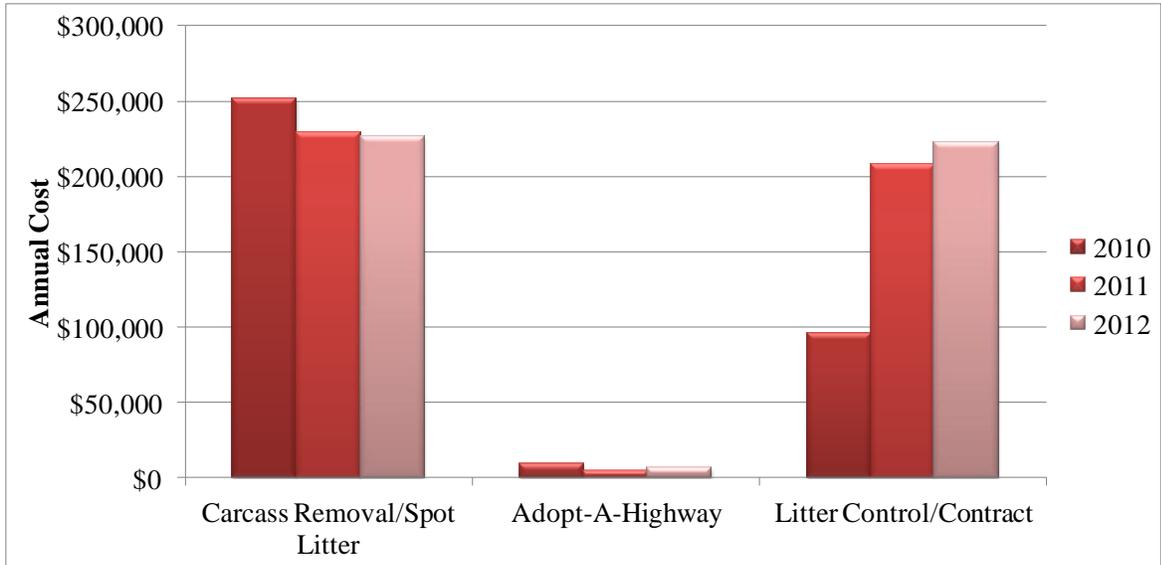


Figure B5. Breakdown of litter clean-up costs in Region 3, 2010 – 2012.



Figure B6. Breakdown of litter clean-up costs in Region 4, 2010 – 2012.



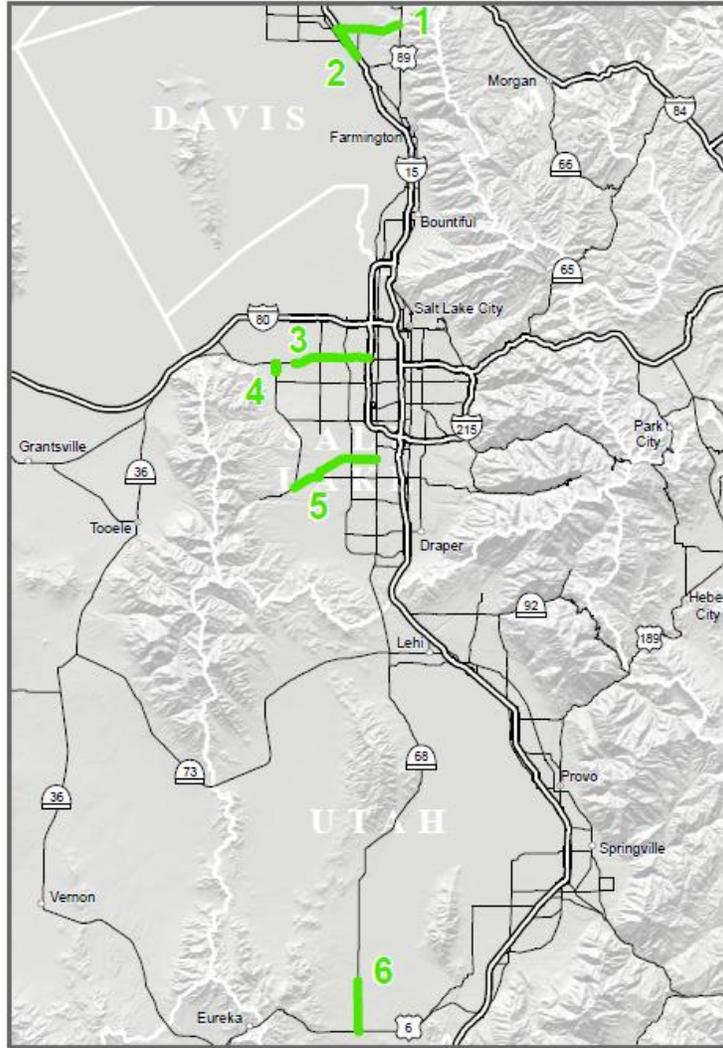


Figure C2. High litter roadways visited during windshield survey. Map provided by UDOT.

Table C1. Description of locations for windshield survey.

Location Route	Mileage Start	Mileage End	Direction	View
SR-193	0.521	5.534	Eastbound	Both sides
I-15	333.378	334	Southbound	Right hand side
SR-201	8.684	14.572	Westbound	Right hand side
SR-111	10	10.556	Northbound	Both sides
SR-48	3.023	10.417	Eastbound	Both sides
SR-68	0	4	Northbound	Both sides

**APPENDIX D: DOT HIGHWAY LITTER DATA**

State	Type of Litter and Percentages	Annual Amount of Litter Removed	Source of Litter	Location of Litter	Accidental vs. Deliberate Litter	Annual Cost	Prevention Campaigns			Max. Poss. Fine
							Public Campaigns	Public Involved?	Inmate Collection on Crews	
Arizona	Food cartons and wrappers, napkins, plastic utensils, cans and bottles, vehicle parts [1]	1.6 million tons [2]	NR	NR	60% - Deliberate	\$3 million [2]	"Don't Trash Arizona" [3]	AAH Program [2]	Yes	\$500 - \$1000 [4]
California	Cigarette butts are the most commonly found item [5]	NR	Pedestrians, drivers, etc. [5]	NR	NR	\$41 million [6]	"Don't Trash California" [7]	AAH Program [7]	NR	\$1000 [6]
Colorado	NR	75,250 cubic yards [8]	NR	NR	NR	\$4.8 million [8]	NR	AAH Program [8]	NR	\$500 - \$1000 [9]
Missouri	Fast Food Waste (33%), Paper (29%), Aluminum (28%), Glass (6%), Plastic (2%), Other (2%) [10]	NR	NR	NR	NR	\$6 million [10]	"No More Trash" [11]	AAH Program [12]	NR	\$1000 [9]
Nevada	NR	NR	NR	NR	NR	\$5.8 million [13]	NR	AAH Program [14]	Yes	NR
Oklahoma	NR	NR	Uncovered loads & trucks [15]	55% Highways [15]	60% - Deliberate [15]	\$4 million [15]	"Trash Off" [15]	AAH Program [15]	NR	\$200 - \$2000 [16]
Texas	NR	NR	NR	NR	NR	NR	"Don't Mess with Texas" [17]	AAH Program [18]	NR	\$2000 [9]
Washington	Glass (25%), Metal (15%), Organics (13%), CDL Wastes (13%), Paper (10%), Other (14%) [19]	5000 tons [20]	NR	Urban Roadways [19]	60% - Deliberate 40% - Accidental [19]	\$3 million [20]	"Litter and it will Hurt" [21]	AAH Program [21]	Yes	\$1000 [9]
West Virginia	Paper (59%), Cans (16%), Bottles (6%), Plastic (6%), Other (13%) [22]	NR	NR	NR	NR	\$1 million [22]	NR	AAH Program [23]	Yes	\$2000 [9]
Wyoming	NR	100 tons [24]	NR	NR	NR	\$2 million [24]	NR	AAH Program [25]	NR	\$750 [9]

Table D1. Summary of State DOT Highway Litter Data. NR = Not Reported; AAH = Adopt-A-Highway